# Visual Impairment/Intracranial Hypertension

From HumanResearchWiki

## Contents



## Introduction

Visual degradation is a newly recognized phenomenon that some NASA astronauts have apparently experienced; including optic-disc edema, globe flattening, choroidal folds, and hyperopic shifts, as well as documented post-flight elevated intracranial pressure (ICP). Astronauts receive both pre-flight and post-flight ophthalmologic exams. In the post-flight time period, some individuals have experienced transient changes while others have experienced changes that persist with varying degrees of severity. While the underlying etiology of both visual impairment and spaceflight-induced intracranial hypertension is unknown at this time, the NASA medical community suspects that the microgravity-induced cephalad fluid shift and commensurate changes in physiology play a significant role.[1] Other potential in-flight factors that are receiving consideration include alterations in carbon dioxide metabolism, alterations in serum sodium concentration, and the influence of exercise on ICP and intraocular pressure (IOP).[1]

## Clinical Priority and Clinical Priority Rationale by Design Reference Mission

*One of the inherent properties of space flight is a limitation in available mass, power, and volume within the space craft. These limitations mandate prioritization of what medical equipment and consumables are manifested for the flight, and which medical conditions would be addressed. Therefore, clinical priorities have been assigned to describe which medical conditions will be allocated resources for diagnosis and treatment. "Shall" conditions are those for which diagnostic and treatment capability must be provided, due to a high likelihood of their occurrence and severe consequence if the condition were to occur and no treatment was available. "Should" conditions are those for which diagnostic and treatment capability should be provided if mass/power/volume limitations allow. Conditions were designated as "Not Addressed" if no specific diagnostic and/or treatment capability are expected to be manifested, either due to a very low likelihood of occurrence or other limitations (for example, in medical training, hardware, or consumables) that would preclude treatment. Design Reference Missions (DRMs) are proposed future missions designated by a set of assumptions that encompass parameters such as destination,*

*length of mission, number of crewmembers, number of Extravehicular Activities (EVAs), and anticipated level of care. The clinical priorities for all medical conditions on the Exploration Medical Condition List (EMCL) can be found here (https://humanresearchwiki.jsc.nasa.gov/index.php?title=Category:All_DRM). The EMCL document may be accessed here (https://humanresearchwiki.jsc.nasa.gov/images/6/62/EMCL_RevC_2013.pdf).*

| Design Reference Mission | Clinical Priority | Clinical Priority Rationale |
|---|---|---|
| Lunar sortie mission<br><br>Assumptions:<br>▪ 4 crewmembers (3 males, 1 female)<br>▪ 14 days total<br>▪ 4 EVAs/crewmember<br>▪ Level of Care 3 | Shall | Given that intracranial hypertension appears to be causing both short- and long-term adverse health effects, a NEA mission will most likely necessitate implementation of in-flight monitoring and either preventive or problem-based treatment. Because the mechanisms underlying increased intracranial pressure have not yet been elucidated, preventive, diagnostic, and treatment protocols for future missions are TBD. |
| Lunar outpost mission<br><br>Assumptions:<br>▪ 4 crewmembers (3 males, 1 female)<br>▪ 180 days total<br>▪ 90 EVAs/crewmember<br>▪ Level of Care 4 | Shall | Given that intracranial hypertension appears to be causing both short- and long-term adverse health effects, a NEA mission will most likely necessitate implementation of in-flight monitoring and either preventive or problem-based treatment. Because the mechanisms underlying increased intracranial pressure have not yet been elucidated, preventive, diagnostic, and treatment protocols for future missions are TBD. |
| Near-Earth Asteroid (NEA) mission<br><br>Assumptions:<br>▪ 3 crewmembers (2 males, 1 female)<br>▪ 395 days total<br>▪ 30 EVAs/crewmember<br>▪ Level of Care 5 | Shall | Given that intracranial hypertension appears to be causing both short- and long-term adverse health effects, a NEA mission will most likely necessitate implementation of in-flight monitoring and either preventive or problem-based treatment. Because the mechanisms underlying increased intracranial pressure have not yet been elucidated, preventive, diagnostic, and treatment protocols for future missions are TBD. |

# Initial Treatment Steps During Space Flight

*A link is provided to a prior version of the International Space Station (ISS) Medical Checklist, which outlines the initial diagnostic and treatment steps recommended during space flight for various conditions which may be encountered onboard the ISS. Further diagnostic and treatment procedures beyond the initial steps outlined in the Medical Checklist are then recommended by the ground-based Flight Surgeon, depending on the clinical scenario. Please note that this version does not represent current diagnostic or treatment capabilities available on the ISS. While more recent versions of this document are not accessible to the general public, the provided version of the checklist can still provide a general sense of how medical conditions are handled in the space flight environment. Medical Checklists will be developed for exploration missions at a later point in time.*

Please note this file is over 20 megabytes (MB) in size, and may take a few minutes to fully download.

ISS Medical Checklist (http://www.nasa.gov/centers/johnson/pdf/163533main_ISS_Med_CL.pdf)

# Capabilities Needed for Diagnosis

*The following is a hypothetical list of capabilities that would be helpful in diagnosis. It does not necessarily represent the current capabilities available onboard current spacecraft or on the ISS, and may include capabilities that are not yet feasible in the space flight environment.*

- Non-Invasive ICP measurement
- Imaging [such as Magnetic Resonance Imaging (MRI) and ultrasound]

# Capabilities Needed for Treatment

*The following is a hypothetical list of capabilities that would be helpful in treatment. It does not necessarily represent the current capabilities available onboard current spacecraft or on the ISS, and may include capabilities that are not yet feasible in the space flight environment.*

- TBD

# Associated Gap Reports

*The NASA Human Research Program (HRP) identifies gaps in knowledge about the health risks associated with human space travel and the ability to mitigate such risks. The overall objective is to identify gaps critical to human space missions and close them through research and development. The gap reports that are applicable to this medical condition are listed below. A link to all of the HRP gaps can be found here (http://humanresearchroadmap.nasa.gov/Gaps/).*

1.01 - We do not know which emerging technologies are suitable for preflight medical screening for exploration missions.
2.01 - We do not know the quantified health and mission outcomes due to medical events during exploration missions.
2.02 - We do not know how the inclusion of a physician crew medical officer quantitatively impacts clinical outcomes during exploration missions.
3.01 - We do not know the optimal training methods for in-flight medical conditions identified on the Exploration Medical Condition List taking into account the crew medical officer's clinical background. (Closed)
3.03 - We do not know which emerging technologies are suitable for in-flight screening, diagnosis, and treatment during exploration missions.
4.01 - We do not have the capability to provide a guided medical procedure system that integrates with the medical system during exploration missions.
4.02 - We do not have the capability to provide non-invasive medical imaging during exploration missions.
4.14 - We do not have the capability to track medical inventory in a manner that integrates securely with the medical system during exploration missions.
4.15 - Lack of medication usage tracking system that includes automatic time stamping and crew identification
4.17 - We do not have the capability to package medications to preserve stability and shelf-life during exploration missions.
4.24 - Lack of knowledge regarding the treatment of conditions on the Space Medicine Exploration Medical Condition List in remote, resource poor environments (Closed)
5.01 - We do not have the capability to comprehensively manage medical data during exploration missions.

# Other Pertinent Documents

# List of Acronyms

| | |
|---|---|
| **D** | |
| DRM | Design Reference Mission |
| | |
| **E** | |
| EMCL | Exploration Medical Condition List |
| EVA | Extravehicular Activity |
| | |
| **H** | |
| HRP | Human Research Program |
| | |
| **I** | |
| ICP | Intracranial Pressure |
| IOP | Intraocular Pressure |
| ISS | International Space Station |
| | |
| **M** | |
| MB | Megabyte |
| | |
| **N** | |
| NASA | National Aeronautics and Space Administration |

| | |
|---|---|
| NEA | Near Earth Asteroid |
| | |
| **T** | |
| TBD | To Be Determined |

# References

1. Otto, C.; Alexander, DJ; Gibson, CR; Hamilton, DR; Lee, SMC; Mader, TH; Oubre, CM; Pass, AF; Platts, SH; Scott, JM; Smith, SM; Stenger, MB; Westby, CM; Zanello, SB. Evidence Report: Risk of spaceflight-induced intracranial hypertension and vision alterations. Human Research Program: Human Health Countermeasures Element. (2012). http://humanresearchroadmap.nasa.gov/Evidence/reports/VIIP.pdf

# Last Update

This topic was last updated on 8/13/2014 (Version 2).



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